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TECHNICAL REPORT

67-14-CM

**PUNCH-CARD INFORMATION RETRIEVAL SYSTEMS
FOR FLASHBLINDNESS PROTECTION RESEARCH
I. PHOTOCROMIC MATERIALS**

by

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NATICK LABORATORIES
Natick, Massachusetts 01760



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PUNCH-CARD INFORMATION RETRIEVAL SYSTEMS FOR FLASHBLINDNESS
PROTECTION RESEARCH

I. PHOTOCHROMIC MATERIALS

by

Richard N. Macnair
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November 1966

Clothing and Organic Materials Division
U.S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

FOREWORD

This report was prepared by Dr. Richard N. Macnair, Materials Research Branch, as a manual for information storage and retrieval by means of hand punch cards for use in a study of photochromic materials. It is the first of a proposed series of reports and presents the basis for an information retrieval system designed to make readily available all information gathered and coded during the search for and the development of materials for flashblindness protection.

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ABSTRACT

The information retrieval system described herein was set up to include photochromic materials, organic semiconductors, image converter devices, and other protective systems.

Two types of data are coded in the system:

- 1) General information; including authors, publications, dates, and comments.
- 2) Specific data for individual compounds and subjects.

The specific data described in this report pertain to photochromic materials, the area of present in-house research at the U.S. Army Natick Laboratories (NLABS). Subject and compound codes for other areas will be prepared and reported separately when needed. Methods for coding the data on 5 x 8-inch, double-row hand punch cards are presented. Information is retrieved in any order by sorting the coded cards for subjects, authors, dates, and publications, thus providing a versatile system for obtaining any information previously coded.

PUNCH-CARD INFORMATION RETRIEVAL SYSTEMS FOR FLASHBLINDNESS PROTECTION RESEARCH

I. PHOTOCHROMIC MATERIALS

I. Introduction

A literature search necessary for the in-house study of photochromic compounds has indicated the large volume of available data pertinent to flashblindness protection research. The research in photochromics provided an excellent starting point for collecting and cataloguing the information. Development was begun on a punch-card information retrieval system to encompass the whole area of flashblindness protection while specifically concentrating on photochromics.

Several methods are known which could be used for such a system. Scheele¹, in an excellent treatise on this subject, describes machine, needle, and visual punch-card methods in detail and evaluates them for various purposes. Casey and Perry², in an earlier text, discuss machine and needle punch-card methods and include some non-punch-card methods, but these will not be presented because they do not fit the specific needs and resources of NLABS.

The machine punch-card method ¹⁻⁴ includes all systems in which card handling is entirely mechanical. The cards pass through the machine separately and in succession. They are not perforated before use.

The needle punch-card method ^{1,2} includes all systems in which the cards are manipulated with the aid of needles or needling devices. These cards, which are already perforated, are either edge-notched or are internally slit between holes during use.

The visual punch-card method includes all optical coincidence systems in which the cards are examined visually through holes to detect unpunched cards. These systems work on a principle contrary to the other punch-card methods. The cards are unperforated before use.

Machine punch-card methods are versatile and can be used in problems of small, medium, or large scope (under 10,000 cards; 10,000 to 500,000 cards; or over 500,000 cards). However, they are expensive, particularly in terms of the non-recurring small-scope problem. Needle and visual punch-card methods are limited to small and medium-scope problems and are generally much less expensive, but this depends largely on the size and type of problem. Scheele⁵ concluded that "needle punch-cards and visual punch-cards are the ideal tools for the individual intellectual worker or for the accomplishment of some specific task."

II. Approach

The needle punch-card method was chosen for use in the flash-blindness program for several reasons. First, its versatility for indexing information on small-scope problems (under 10,000 cards) is well known^{1,2,4,6-9}. Second, its cost is nominal; it requires no large equipment but rather only a few readily available accessories, such as hand punches. Third, a supply of 5 x 8-inch, double-row punch cards, closely resembling those recommended by Cox, Bailey, and Casey⁶ for a chemical bibliography, was on hand. Fourth, the scope of the problem was relatively small at the beginning and the information could easily be divided into separate sections for further convenience. For example, the data on photochromic compounds were grouped separately from the data on electro-optical systems to keep the volume of cards handled at any one time at a relatively convenient level. If at any future time the volume of cards should become cumbersome, a mechanical sorting system could be used.

To implement setting up the needle punch-card system, the procedure of Cox et al⁶ was followed. These authors recommend starting immediately on the literature search and recording the abstracts and/or data on the cards. This procedure engendered rapid familiarization with the subject matter and made easier the classification of the material and the setting up of categories to encompass future references. Physical properties data were collected for triphenylmethane and numerous derivatives including pararosaniline, p,p',p''-tris-N-methylanilinomethane, crystal violet and ethyl violet. After about 500 references had been collected and the authors, dates, sources, abstracts, and other pertinent data recorded, the references were grouped according to their physical properties. This provided the basis for the subject index. Further search for articles, reports, and reviews about photochromy gave a good indication of the classes of compounds involved and the number of individual compounds that should be included. The coding outline was then set up and at the same time a study of appropriate codes and card designs was begun. These codes and designs are discussed in Sections V and VI. After the coding outline was set up, numerous cards were coded and the system was checked out for workability.

III. Code Types

A. Direct

A direct code is the most useful and straightforward, from the point of view of subject retrieval. However, it is also the most space-consuming; most if not all direct codes have a 1-to-1 subject-to-card-hole ratio. If the material to be coded is limited and growth

is not expected, a card with sufficient space can be selected and all the data can then be direct-coded on the chosen card, one item per hole. But this cannot be done if the volume of information is large. Consequently, in the system described, the direct code is used only in the Specific Subjects and Comments Indices presented in Part VIII, H and I, respectively.

B. Indirect

An indirect code is the most useful when the volume of data to be coded greatly exceeds the space on the card, that is, when the ratio of subjects to card-holes exceeds 1-to-1. There are two general types of indirect codes, as follows:

1. Alphabetical

These are the most common in author indexes. For this purpose several codes have been developed, such as the NZ-7-4-2-1 and O-I-E-C-B codes explained by Cox, Bailey and Casey⁶ and the triangle codes discussed by Scheele¹. A revised O-I-E-C-B code similar to that reported by Casey et al⁸ was chosen for this system because it includes subdivisions of the letter S, which should simplify coding and decoding. The code was further simplified and made more accurate by subdividing M into: before Mac, Mac to Maz to Mc, and after Mc (Casey subdivided M into: before Mac; Mac, Mc; and after Mc). This code is described in detail in the author index portion of the Coding Outline (Section VIII).

2. Numerical

Several numerical codes are described by Scheele¹, and others⁶⁻⁹. They include the common 7-4-2-1 code and various triangle codes that are related to the alphabetical triangle codes mentioned above. All the triangle codes seemed to be too space-consuming so the ordinary 7-4-2-1 arrangement was chosen for the publication date, source, applied research tasks, compound classes, and devices in this system. Specific instructions for the 7-4-2-1 code are described under part C. of the Coding Outline.

IV. Punch-Card Design

The design of the punch-card for an information retrieval system of this type begins with a choice of the basic card. This can be done before the work commences if one has some prior knowledge of the extent of the desired system and the relative capacities of the available cards. The basic card chosen for this system was a 5 x 8-inch, double-row-punched, hand punch-card having holes numbered consecutively except for eight holes at the top right edge (see Appendix). Cox et al⁶ used a similarly punched card and this greatly influenced our choice.

After the basic card was selected, the literature search began. The choice of indexes was based on the information obtained and an estimate was made of the capacity needed for each. Then the indexes were arranged on the card in the most logical and compact fashion possible. Because the format was rewritten and revised several times during the collection of the data, the arrangement also was revised to be as functional as possible. The card shown in the Appendix represents the final design. Examination of this card indicates that its hole-numbering system is neither logical nor functional for our design. Therefore, the numbering system will be changed when new cards are ordered. The format that will appear on the new cards is described in the section titled Coding Outline (Section VIII).

V. General Coding and Decoding Instructions

A. Coding

1. With the help of the coding outline (Section VIII), mark the holes to be punched in pencil (preferably red or blue).
2. Check the cards for mistakes before they are punched.
3. Punch the holes, using a shallow punch, such as McBee model 5201, for the outer row of holes; an O-slot punch, such as McBee model 5203, for the inner row of holes; and a deep-slot punch, such as McBee model 5227 for the inner and outer holes together. All the holes may be punched at one sitting.
4. Whenever a change is necessary or a wrong punch is made, cover the notch by pasting a card saver (McBee Keysort No. K4SD) over the edge of the card and repunch. Complete directions for the use of card savers are located on the inside cover of each card-saver booklet. If necessary, the card may be replaced.

B. Decoding

1. Obtain the code numbers pertaining to the subjects or other categories of interest from the Coding Outline.
2. Select a group of cards and align the holes with the help of an alignment block or small desk file or other means.
3. Push a needle through the group of cards at the proper hole position for the desired subject. The needle (available from the McBee Company) should be about 10 inches long and two-thirds the diameter of the hole. The order of needling a series of holes for a single subject is not critical.

4. When the cards are strung on the needle, shake or riffle them and let the free cards fall.

5. To remove the 0-slotted cards that have dropped down part way, remove the needle from the original hole and needle one of the unmarked corner holes, or vice versa if more than one needle is available, and again let the free cards fall.

6. When retrieving information coded indirectly by a numerical code such as the 7-4-2-1, it may be necessary to needle all the holes in a particular coding block if the code number is 7, 4, 2, or 1. For example, when hole number 7 is needed, all cards having code combinations containing number 7 will be obtained along with the desired cards. Needling the remaining holes (4, 2, and 1) will let the undesired cards drop out since none of these is punched on the desired cards. Similar situations that may be encountered with indirect alphabetical codes, can be treated in a like fashion.

VI. Coding Outline*

A. Author Index (coded alphabetically)

1. Illustration

	o	o o o o o	o o o o o	o o o o o
Single	O	I E C B	O I E C B	O I E C B
Author	Field 1	Field 2	Field 3	

2. Location

a. This index is located at the upper left-hand corner of the card shown in the Appendix.

b. Only the outer row of holes (numbered 7 through 21 plus the un-numbered corner hole) on the card is used for this index.

3. Coding Directions

a. If the publication has only one author, punch the single-author hole and, using the alphabetical coding table (below), code the first, second, and third letters (or appropriate combinations of letters) of the last name, one letter or combination of letters per field, from left (field 1) to right (field 3).

b. If the article has 2, 3, or more authors, code the first letter or letters of each last name according to the coding outline, one author per field.

*Before coding any cards see the general coding instructions, Section V.

4. Alphabetical Coding Table

<u>Letter</u>	<u>Punch*</u>	<u>Letter</u>	<u>Punch*</u>
A	No punch	N	IECB
B	B	O	O
C	C	P	OB
D	CB	Qu	OC
E	E	R	OCB
F	EB	S before Sch	OE
G	EC	Sch	OEB
H	ECB	S after Sch	OEC
I	I	T	OECB
J	IB	U	OI
K	IC	V	OIB
L	ICB	W	OIC
M before Mac	IE	X	OICB
Mac to Maz to Mc	IEB	Y	OIE
M after Mc	IEC	Z	OIEB

*See the general coding instructions, Section V.

B. Publication Date Index

1. Illustration

o o	o o o o	o o o o
2 1	7 4 2 1	7 4 2 1
Century	Tens	Units
field	field	field

2. Location

a. This index is located at the upper right-hand corner of the card shown in the Appendix.

b. Only the outer row of holes is used.

3. Coding Directions

a. If the material was published in the 18th century, punch hole 1 in the century field.

b. If the material was published in the 19th century, punch hole 2 in the century field.

c. If the material was published in the 20th century, no punch is necessary.

d. The 21st century may be indicated in the future by punching both holes 1 and 2.

e. The decades and years are coded in the tens and units fields, using the first portion of the coding table for the 7-4-2-1 numerical code below. For example, for the year 1890, punch hole 2 in the century field (for the 19th century), holes 7 and 2 in the tens field (for the 10th decade of the century), and nothing in the units field (to indicate the first year of the decade).

C. Publication Source Index

1. Illustration

o o o o
7 4 2 1

2. Location

- a. This index is located at the top center of the card.
- b. Only the outer row of holes (numbered 3 through 6 on the basic card) is used.

3. Coding Directions

- a. Code the publications according to the assignments and numerical code given below.
- b. Assignments and code may be made to a maximum capacity of 14.

4. Coding Table for the 7-4-2-1 Numerical Code

<u>Number</u>	<u>Punch*</u>	<u>Number</u>	<u>Punch*</u>
0	no punch	9	7, 2
1	1	10	7, 2, 1
2	2	11	7, 4
3	2, 1	12	7, 4, 1
4	4	13	7, 4, 2
5	4, 1	14	7, 4, 2, 1
6	4, 2		
7	7		
8	7, 1		

*See the general coding instructions, Section V.

5. Code Assignments

<u>Number</u>	<u>Source</u>
1.	U. S. periodical
2.	Foreign periodical
3.	Book
4.	U. S. Patent
5.	Foreign patent
6.	Report - Army
7.	Report - Navy
8.	Report - Air Force
9.	Report - government agency other than Army, Navy, and Air Force
10.	Report - civilian, academic, or industrial (non- government contract)
11.	Dissertation or thesis

D. Research Phase Index

1. Illustration

o o o o

7 4 2 1

2. Location

a. This index is located at the lower left-hand side of the card.

b. Only the outer row of holes (numbered 34-37 on the basic card) is used.

3. Coding Directions

- a. Code the phases according to the assignments given below.
- b. Assignments and code are made to a maximum capacity of 14.

4. Phase Assignments*

<u>Number</u>	<u>Phase</u>
1	Photochromic compounds
2	Organic semiconductors
3	Image converter systems
4	Electroplating systems
5	Activated triplet-state devices
6	Electro-optical systems
7	Eye-response control systems

E. Class of Compound, Device, or System Index

1. Illustration

o o o o o o o o

7 4 2 1 7 4 2 1

Tens Units

field field

2. Location

- a. This index is located at the upper right-hand side of the card.
- b. Only the outer row of holes (numbered 76-83 on the basic card) is used.

*Each phase requires preparation of a separate subject matter outline.

3. Coding Directions

a. Code the classes according to the assignments given below and the numerical coding given in Section C.

b. Code the tens field to its maximum capacity of 14, and the units field to a limit of 9. This will give the index a maximum capacity of 149.

c. Code one card for the most important class. Code duplicate cards for other individual or groups of classes, if necessary. Use code number 31 to indicate a group of classes, if desired. Make new code number assignments for classes pertinent to photochromic compounds research if none have already been made.

4. Code Assignments

<u>Number</u>	<u>Class</u>
1	Anils
2	Azo compounds (amino and hydroxyazo dyes)
3	Benzyl pyridines
4	Bianthrone and analogous compounds
5	Camphor derivatives
6	Ethylene derivatives (stilbene derivatives)
7	Fulgides
8	Hydrazones and osazones
9	Inorganic halides
10	Mercury and silver compounds
11	Miscellaneous inorganic compounds (alkaline earths, lithium imide, lithopone)
12	Miscellaneous organic compounds (chlorophyll, aromatic-halogen complex, fluorescein)
13	Metal hexacarbonyls
14	Nitro compounds (aliphatic and aromatic)

4. Code Assignments (Cont'd)

<u>Number</u>	<u>Class</u>
15	Octaarylbiopyrroles
16	Polymethines
17	Phenothiazines, acridines, phenoxazines, phenazines
18	Quinol derivatives (β -tetrachloro- α -ketonaphthalene and other naphthalenes)
19	Semicarbazones
20	Organic sulfur derivatives (disulfoxides, mercaptans)
21	Spirans (spiopyrans)
22	Thioindigo compounds
23	Arylmethanes (triphenylmethanes)
24	Sydnones
25	Azulenenes
26	Arylsilanes
27	Arylamines
28	Arylphosphines
29	Dithizonates and dithizonenes or formazans
30	Cumulenes
31	Several classes on one article - other classes
32	Metalized dyes
33	Class(es) not given on card or in abstract
34	Cyanines
35	Rhodamines
36	Aromatic Hydrocarbons (other than arylmethanes)
37	Aldehydes and ketones (miscellaneous)

F. Item Index For Compounds, Devices, and Systems

1. Illustration

o o o o	o o o o	o o o o
7 4 2 1	7 4 2 1	7 4 2 1
Hundreds	Tens	Units
field	field	field

2. Location

a. This index is located at the upper left-hand side of the card.

b. Only the outer row of holes (numbered 22-33 on the basic card) is used.

3. Coding Directions

a. This index is divided into three sections, one each for compounds, devices, and systems. Assign the numbers 1-1099, 1100-1299, and 1300-1499, respectively, to these sections. These number assignments are not rigid and can be modified if it becomes necessary or more convenient. More compounds than devices or systems are expected to be coded so more numbers have been assigned to compounds. As yet, only 30 assignments have been made in the compounds section and none in the devices and systems sections.

b. Code the items using the 7-4-2-1 numerical code tabulated in Section C.

c. Code the hundreds field to its maximum capacity of 14 and the tens and units fields to a limit of 9 each. This gives a total index capacity of 1499.

d. If two or more items appear in the same reference, either prepare a separate card for each item or code them as a series or group. Care must be exercised to keep the group coding as simple as possible.

4. Code Assignments*

Compounds (1-1099)

<u>Number</u>	<u>Item</u>
0	No punch - specific compounds, devices, systems not given or irrelevant to this study
1	Triphenylmethanes (see 11 and 13 also)
2	Pararosaniline (see 16 also)
3	p,p' ¹ p''-Tris-(N-methylanilino)methane
4	Crystal violet (see 16 also), and its carbinol
5	Ethyl violet
6	Malachite green (see 16 also) and its carbinol, ring-substituted
7	Toluene (see 11 also)
8	Diphenylmethane (see 11 also)
9	Triphenyl carbinol (see 13 also)
10	Benzene (see 11 also)
11	Series triphenylmethane, diphenylmethane, toluene, benzene, tetraphenylmethane, or parts thereof
12	Tetraphenylmethane (see 11 also)
13	Series Triphenylmethane, triphenyl carbinol, triphenylmethyl chloride, triphenylmethane ethyl ether (ethoxytriphenylmethane), or combinations thereof

*Items in this code may appear by themselves or in a group of compounds accordingly as they appear on the cards.

4. Code Assignments* (Cont'd)

Compounds (1-1099)

<u>Number</u>	<u>Item</u>
14	Triphenylmethyl chloride (see 13 also)
15	Ethoxytriphenylmethane (see 13 also)
16	Series malachite green, brilliant green, crystal violet, methyl violet, and p-dimethylaminophenyldiphenylmethane, fuchsin, and p-rosaniline or combinations thereof
17	p-Dimethylaminophenyl diphenylmethane (see 16 also)
18	Methylene blue
19	Series tri- and tetraphenyl derivatives of C, Si, N, P, Pb, As, Bi, Sb, and Sn
20	Diphenylamine derivatives
21	Fluorescein
22	Triphenylphosphine
23	New fuchsin cyanide - $\left[4,3-(\text{H}_2\text{N})(\text{Me})\text{C}_6\text{H}_3\right]_3 \text{CCN}$
24	Triphenylamine
25	Azulene
26	Tetraphenylsilane
27	Acridine orange, proflavine, and others
28	Cyanine Polymethine group (general)
29	Naphthalene
30	Acetophenone and Benzaldehyde derivatives
31-1099	To be assigned to additional compounds

G. General Subjects Index

1. Illustration

o o o o	o o o o
7 4 2 1	7 4 2 1
Tens	Units
field	field

2. Location

a. This index is located at the lower right-hand side of the card.

b. Only the outer row of holes (numbered 68-75 on the basic card) is used.

3. Coding Directions

a. Code the general subjects according to the assignments indicated below, using the numerical code given in section C. In this process, judgments must be made as to what general subject is most applicable for coding the reference, and if there are two applicable subjects, which of the two is more important. Less important general subjects are coded in a special part of the Specific Subjects Index (Section H). New assignments should be made when necessary using the remaining numbers in the index consecutively.

b. Code the tens field to its maximum capacity of 14 and the units field to a limit of 9. This gives the index a total capacity of 149.

4. Code Assignments

<u>Number</u>	<u>Subject</u>
1	Synthesis
2	Purification and analysis
3	Structure
4	Spectra

4. Code Assignments (Cont'd)

<u>Number</u>	<u>Subject</u>
5	Solution properties
6	Solid and liquid properties
7	Reactions and derivatives
8	Photochromic response
9	Photochromic devices (end use items)
10	Optical properties
11	Kinetics
12	Electrical properties
13	Mechanisms

H. Specific Subjects Index

1. Description

a. This is a direct-code index with the numbering system given below under "Old Card" (to be used until the present supply of cards is depleted).

b. A new numbering system ("New Card"), consecutive from 1-110, has been planned for the same hole arrangement and will be used on cards purchased in the future. Both numbering systems are discussed.

2. Location

a. The entire double row of holes numbered 38-67 and 127-156 at the bottom of the card constitutes the major part of this index.

b. The inner row of holes (numbered 84-126 on the left and top, and 164-170 on the right side of the card) constitute the remaining section of this index.

3. Coding Directions

a. Code the specific subjects according to the assignments given below, using the direct code method, one item per number per hole.

b. Begin coding the cards with hole 57 and continue to 38; start again at 156 and code all around the inner row to 84, then from 170 to 164 (in the new numbering system, the same order of holes will be used but they will be renumbered 1-110 consecutively).

4. Code Assignments

a. A few subjects that occur in the General Subjects Code Assignments are expected to occur together in the same reference. The least emphasized or less important of these should be considered specific subjects. These have been assigned code numbers in the 156-132 block (31-55 on the new cards) in this index, as shown below. This block was chosen to reduce the usage of the inner row of holes that is expected and thereby make the coding and decoding somewhat simpler.

<u>New Cards</u>	<u>Old Cards</u>	
31	156	Synthesis
32	155	Purification and elemental analysis
33	154	Structure
34	153	Spectra
35	152	Kinetics
36	151	Solid and liquid properties
37	150	Solution properties
38	149	Electrical properties
39	148	Optical properties
40	147	Reactions and derivatives
41	146	General treatment or discussion
42	145	Review
43	144	Photochromic response
44	143	Photochromic devices

b. The remaining blocks of numbers in this index (67-38, 131-84, and 170-164, or (1-30 and 56-110 on the new cards) have been set aside for specific subjects pertaining only to the major general subject appearing in any reference, i.e., the subject coded in the General Subjects Index. These subjects have been assigned code numbers under one of twelve appropriate General Subjects headings thus far being used and listed below. New code numbers should be assigned to new subjects and new headings should be added when needed. Numbers not listed have not yet been assigned to subjects.

1) Synthesis

<u>New Cards</u>	<u>Old Cards</u>	
26	42	Ion exchange
41	146	General
42	145	Review

2) Purification and Analysis

<u>New Cards</u>	<u>Old Cards</u>	
0	0	No punch, detail not yet on card
1	67	Vapor phase chromatography
2	66	Sublimation
3	65	Identification of impurities
4	64	Polarography
5	63	Reprecipitation (with added reagent)
26	42	Recrystallization
27	41	Distillation
28	40	Paper chromatography
29	39	Column chromatography
30	38	Thin layer chromatography
41	146	General
42	147	Review

3) Structure

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Resonance structures
2	66	Crystal structure
3	65	Substituent effects
4	64	Electronic levels and valency bonds
5	63	Quinoid form vs. carbinol form and others
6	62	Color and planarity
7	61	Environmental effects including solvent, pH
26	42	Molecular structure
27	41	Steric effects
28	40	Leuco form
29	39	Carbonium ion or ionic form
30	38	Constitution and color, halochromism
41	146	General
42	145	Review

4) Spectra

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Electron spin resonance
2	66	Electron paramagnetic resonance
3	65	Electronic

4) Spectra (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
4	64	Infrared, including near and far
5	63	Reflection
6	62	Emission
7	61	Absorption
8	60	Raman
9	59	Solid state, including films
10	58	Solution
11	57	High temperature
12	56	Low temperature
13	55	Pellet or disc
14	54	Mull
15	53	Neat
16	52	Gas
17	51	Extinction coefficients
18	50	Quantitative
19	49	Polarization spectra
20	48	Pressure
21	47	Before and/or during and/or after Photolysis (irradiation)
22	46	At various pH values
23	45	Effect of water vapor
24	44	Energy and intensity data

4) Spectra (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
25	43	π -Electronic transitions
26	42	Ultraviolet
27	41	Visible
28	40	Nuclear magnetic resonance
29	39	Phosphorescence
30	38	Fluorescence and luminescence
41	146	General
42	145	Review
56	131	Mass spectra
57	130	Multiple-charged ions
58	129	Constitution and spectra (substituent effects, free radicals)
59	128	Vibrational structure
60	127	Aggregation
61	126	Spectral shifts
62	125	Effect of solvent

5) Solution Properties

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Prototropy and protolysis
2	66	Solubility
3	65	Viscosity

5) Solution Properties (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
4	64	Tautomeric equilibrium
5	63	pH (acidity)
6	62	Polarity
7	61	Hydration
8	60	Conductivity (see Electrical properties)
9	59	Dielectric constant (see Electrical properties)
10	58	Aggregation or association
11	57	Temperature dependence
12	56	Solvation
13	55	Color
14	54	Weak acids
26	42	Solvent effects
27	41	Diffusion
28	40	Ionization and dissociation
29	39	Acid-base phenomena
30	38	pK_a (acidity)
41	146	General
42	145	Review

6) Solid and Liquid Properties

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Parachor
2	66	Density
3	65	Vapor pressure
4	64	X-ray diffraction
5	63	Conductivity (see Electrical properties)
6	62	Dielectric constant (see Electrical properties)
7	61	Anisotropy and dichroism
8	60	Ionization constant
9	59	Water vapor effect
10	58	Melting point
11	57	Boiling point
12	56	Heat of combustion
13	55	Heat of fusion
14	54	Heat of formation
15	53	Heat of transition
16	52	Free energy
17	51	Magnetic rotation
18	50	Rotativity
19	49	Polarizability
20	48	Planarity

6) Solid and Liquid Properties (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
21	47	paramagnetic, diamagnetic, and ionic susceptibilities
22	46	Magnetic double refraction
23	45	Bond dissociation energies
24	44	Heat capacity
25	43	Specific heat
26	42	Dipole moments
27	41	Magnetic susceptibility
28	40	Absorptivity
29	39	Compression
30	38	Critical state
41	146	General
42	145	Review
55	131	Kerr constants
56	130	Refractivity
57	129	Temperature dependence (See Solution Properties)
58	128	Entropy
59	127	Solubility

7) Reactions and Derivatives

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Methyl derivatives
2	66	Pyridine analogs
3	65	With triphenylphosphine
4	64	Dark reactions
5	63	Photoreduction
6	62	Photooxidation
7	61	Dealkylation
8	60	Mechanisms
9	59	Photosensitized oxidation
10	58	Photosensitized reduction
11	57	Intermolecular energy transfer
12	56	Free radicals
13	55	Nitrate
14	54	Hydroxylamine derivative
15	53	Perchlorate
16	52	Leuco base
17	51	Solution (including solid solution or gel)
18	50	Quantum yield
19	49	Electrolysis
20	48	Solid

7) Reactions and Derivatives (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
21	47	Bound state
26	42	Picrate salt
27	41	Oxidation general
28	40	Reduction general
29	39	Chromous sulfate reduction
30	38	Lead peroxide oxidation
41	146	General
42	145	Review

8) Photochromic Response

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Isotope exchange
2	66	Enolization
26	42	Correlation with physical properties
27	41	Photochromy
28	40	Solid State
29	39	Solution
30	38	Temperature dependence (see Solution Properties)
41	146	Review
42	145	General

9) Photochromic Devices (Nothing assigned as yet)

10) Optical Properties

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Critical angle of reflection
2	66	Optical constants
3	65	Quantum yield
4	64	Solution
5	63	Solid
6	62	Light diffusion
7	61	Optical density
26	42	Optical rotation
27	41	Birefringence
28	40	Refractive index
29	39	Optical rotatory dispersion
30	38	Coefficient of reflection
41	146	General
42	145	Review

11) Kinetics

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Color fading
2	66	Isotope exchange
3	65	Effect of solvent

11) Kinetics (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
4	64	Base catalysis
5	63	Acid catalysis
6	62	Change of pseudo to real base
41	146	General
42	147	Review

12) Electrical Properties

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Polarographic studies and electroreduction
2	6	Oxidation potentials and half-wave potentials
3	65	Semiconduction
4	64	Piezoelectric properties
5	63	Superconductors
6	62	Temperature dependence (see Solution Properties)
7	61	Electroendosmosis
8	60	Films
9	59	Surface potential
10	58	Dark resistivity
11	57	Dark conduction
12	56	Absorption, desorption, and photosorption of gases
13	55	Equivalent conductance

12) Electrical Properties (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
14	54	Specific conductivity
15	53	Effect of atmosphere, i.e., oxygen, air
16	52	Zeta potentials
17	51	Resistance
18	50	Thermal activation energy of dark conduction
19	49	Solvent effects and interactions
20	48	Cyclic voltamperometry
21	47	Electron affinity
22	46	Carbonium ion intermediate
23	45	Free radical intermediate
26	42	Photoelectric effects or properties
27	41	Conductivity of solid (including Photoconductivity)
28	40	Conductivity of solution
29	39	Dielectric constant of solid
30	38	Dielectric constant of solution
41	146	General
42	145	Review

13) Mechanisms

<u>New Cards</u>	<u>Old Cards</u>	
1	67	Free radical
2	66	Photo-ionization

I. Comments Index

1. Location and Description

a. The seven holes numbered 157-163 in the inner row on the lower right-hand side of the card in the Appendix constitutes the Comments Index.

b. A new numbering system has been planned for this index to be used on new cards when purchased. The new numbers will be 112-118 where 112 is equivalent to 163, for example.

2. Coding Directions

a. Each comment is direct coded, one comment per hole.

b. Begin coding with hole number 163 using the coding assignments below and continue from left to right.

3. Code Assignments

<u>New Cards</u>	<u>Old Cards</u>	
112	163	Original seen (title and reference correct and complete)
113	162	Original available in our technical library
114	161	Have reprint

3. Code Assignments (Cont'd)

<u>New Cards</u>	<u>Old Cards</u>	
115	160	A copied abstract
116	159	An original abstract
117	158	An idea is recorded, suggested by reading article
118	157	Unassigned

VII. References

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2. Casey, Robert S. and Perry, James W., "Punched Cards, Their Applications to Science and Industry", p. 39, Reinhold Publishing Corporation, New York, N.Y., (1951).
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4. Hartkemeier, H.P., "Punch Card Methods," W.C. Brown and Company, Dubuque, Iowa, (1952).
5. Scheele, Martin, Op. Cit., p. 16.
6. Cox, G.J., Bailey, C.F., and Casey, R.S., "Punch Cards For A Chemical Bibliography," Chem. Eng. News 23, 1623, (1945).
7. Bailey, D.F., Casey, R.S., and Cox, G.J., "Punch Cards For Indexing Scientific Data," Science, 104, 181 (1946).
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VIII. Appendix

Research Area Index										hundreds										tens										units										Author Index										Source Index										Date Index										General Subjects Index										Class Index										Comments Index (Inner Row)										Specific Subjects Index									
128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200																																					

Basic Punch-Card, With Superimposed Index Locations and Field Divisions

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author) U.S. Army Natick Laboratories Natick Massachusetts 01760		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP
3. REPORT TITLE PUNCH-CARD INFORMATION RETRIEVAL SYSTEMS FOR FLASHBLINDNESS PROTECTION RESEARCH. I. PHOTOCHROMIC MATERIALS		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) January 1965 - January 1966		
5. AUTHOR(S) (Last name, first name, initial) Macnair, Richard N.		
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Unclassified
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Information retrieval	8.4		4			
Punched cards	10		4			
Materials	9		2			
photochromic	0		0			
Photochromism	9		2			
Flash blindness	4					
Protection	4					
Coding			8			

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